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Specialty fibers for 160, 320 and 640 Gb/s signal processing

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Abstract: Specialty highly non-linear fibers are experimentally characterized as signal processing components in ultra high-speed OTDM systems. Pulse compression to 359 fs and demultiplexing of 160, 320 and 640 Gb/s signals are demonstrated.

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1. Introduction

Ultra high-speed OTDM communication systems with channel rates approaching 640 Gb/s [1] require fast switches and narrow pulses, which may be obtained with non-linear fibers.
In this paper, we use specialty highly non-linear fibers (HNLF) for compression of a 4 ps optical pulse to 359 fs, and demultiplexing of 160, 320 and 640 Gb/s OTDM data signals.

2. Principle and experimental set-up

Figure 1 shows the experimental set-up. The HNLFs used have a flat dispersion profile (slope ~ 0.017 ps/nm^{2}km, zero dispersion at 1559 nm) and a non-linear coefficient of $\gamma \sim 10\ W^{-1}km^{-1}$.

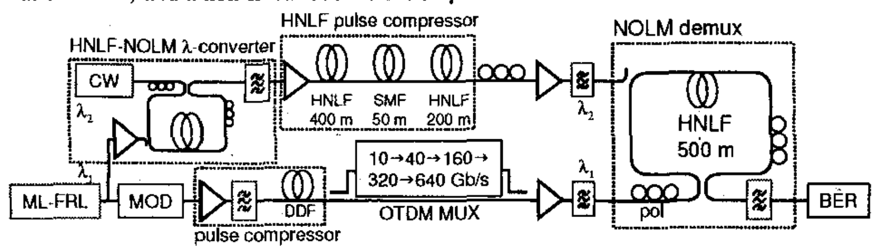

Fig. 1. Schematic set-up.

A mode-locked fiber ring laser (ML-FRL) provides pulses with FWHM of 2.1 ps at a repetition rate of 10 GHz at λ_1 ~ 1556 nm. The pulses are used for the data and to generate the control for the demultiplexer. The data part is modulated (MOD) and compressed through adiabatic soliton compression in a dispersion decreasing fiber (DDF) [2], and multiplexed to a bit rate of 160, 320 or 640 Gb/s in a planar lightwave circuit multiplexer [3]. The multiplexed pulses are transform limited with a FWHM of 600 fs. Demultiplexing takes place in a non-linear optical loop mirror (NOLM) with a single piece of 500 m HNLF. The control pulses (λ_2 ~ 1540 nm) are obtained through wavelength conversion in a second NOLM including 400 m HNLF. The control pulses are compressed in the HNLF-based pulse compressor, consisting of segments of HNLF alternating with SMF (a comb-like dispersion profiled fiber (CDPF) [4]) resulting in quasi-adiabatic soliton compression.

3. Characterizations and BER performance

Figure 2 shows CDPF pulse compression from 3.9 ps to 359 fs. The segments are 200 m HNLF, 20 m SMF and 100 m HNLF, i.e. only 320 m in total. The time-bandwidth product is 1.1 times the transform limit.

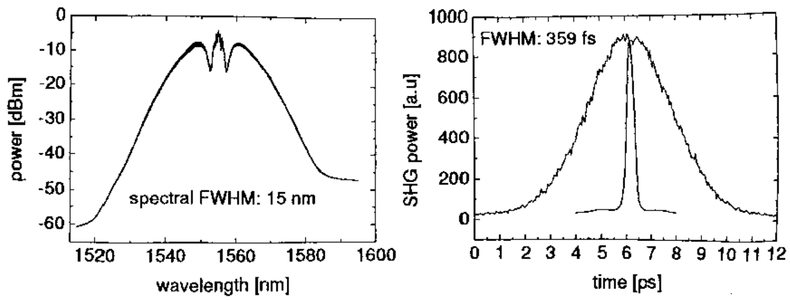

Fig. 2. Left: Spectrum of compressed pulse. Right: Autocorrelations of the input (3.9 ps) and the output (359 fs) pulses.

Fig. 3 shows the multiplexed data and the demultiplexed eye diagrams together with BER curves. From all bit rates it is possible to obtain open eye diagrams (fig. 3 left (bottom)).

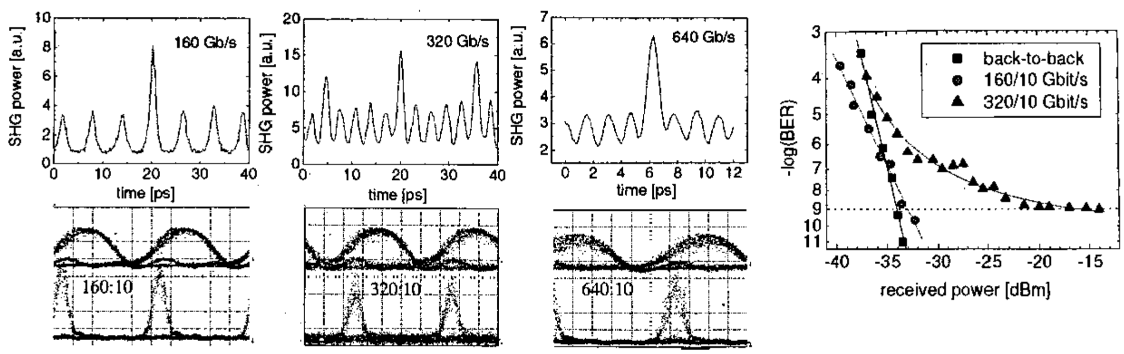

Fig. 3. Left: 160, 320, 640 Gb/s autocorrelation traces (top) and demultiplexed 10 Gb/s eyes (bottom). Right: BER curves.

The 160 and 320 Gb/s demultiplexed eyes are error free and the 640:10 Gb/s demux eyes are promising, but limited by timing jitter of the pulse source (400 fs).

4. Conclusion

We have described the use of new dispersion flattened highly non-linear fibers for pulse compression (down to 359 fs) and demultiplexing of up to 640 Gb/s data.

5. References

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